conduct a prospective more than 10-year follow-up trial of the patients who underwent HCO for medial osteoarthritis of the knee.
**Patients & Methods**: Between 1995 and 2000, 37 knees of 33 patients underwent HCO for severe medial compartment osteoarthritis of the knee. Among them, 29 patients with unilateral HCO were enrolled in this study. The average age of the patients at surgery was 65 years-old (range 52 to 74). We performed a prospective follow-up of these patients. All patients were evaluated before surgery and at three postoperative time points; the first follow-up at the short-term (1-4 years), the second at the middle-term (5-9 years), and the final at the long-term more than 10 years. At each evaluation, we used the Hospital for Special Surgery (HSS) scoring system for clinical examination and measured the femoro-tibial angle (FTA) in a standing anteroposterior view and the tibial inclination angle (IA) in the lateral view for radiological examination. Failure was defined as the need for conversion to a total knee arthroplasty (TKA) and an HSS score < 70 points. In addition, other 20 patients with unilateral HCO were performed three-dimensional quantitative gait analysis to evaluate the dynamic effect of HCO on gait before and one year after the surgery.
**Results**: Twenty-eight, 23 and 19 patients were available for review at the short-term (mean:2.5 years), mid-term (mean:7.1 years) and long-term (mean:14.2 years) follow-up examinations, due to failure, removal, disease or death.
[Conversion to TKA] Only one patient required conversion to total knee arthroplasty during the entire follow-up period.
[Clinical assessment] Among the 19 patients available for the long-term follow-up review, the mean Hospital for Special Surgery knee score was 60 preoperatively, increasing to 92, 90 and 85 at each follow-up period (respectively, p<0.001:paired t-test), with no cases of failure (score<70).
[Radiologocal assessment] The mean preoperative FTA was 181.5° (SD 3.2°, range 176° to 191°). The mean postoperative FTAs were 167.3° (SD 1.3°, range 164° to 170°) at the short-term, 168.0° (SD 1.6°, range 164° to 170°) at the mid-term, and 169.6° (SD 3.2°, range 166° to 180°) at the long-term follow-up. The FTAs at the mid- and long-term follow-up showed no significant difference from those at the short-term. There were no significant post-operative changes in the IA.
For gait analysis, all patients showed the decrease in knee adduction moment during gait.
**Discussion**: HCO has some attractive advantages including simpler technique, immediate postoperative weight-bearing and muscle exercise. Furthermore, distraction osteogenesis in HCO allows small corrections to be made in order to achieve the desired correction in the coronal plane. The fixator can maintain the corrected position until union occurs. The ability to maintain the sagittal alignment, which is difficult to control after stapling or various forms of plating, is an advantage of HCO. The outcomes in the conventional high tibial osteotomies are known to deteriorate over time. However, it is known that the acquisition and maintenance of proper postoperative valgus alignment can provides durable and satisfactory long-term results. Our results suggest that HCO can decrease the decrease medial compartment load during gait postoperatively and maintain the optimal correction angle with lasting long time. These also may explain a satisfactory long-term outcome seen in the present study. There are some limitations to our study. The number of patients involved was small. This study should be supported by the outcomes with long-term follow-up in a much larger group of patients.
**Conclusion**: Our results suggest that HCO can decrease the dynamic loading on the medial compartment of the knee and maintain the acquired coronal correction angle without alteration of the IA at long-term follow up, thus providing a good long-term clinical outcome.
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**B0836**
**Gelatin-grafted poly (L-lactide) electrospun fibrous membranes for healing improvement after rotator cuff repair**

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**Background**: Rotator cuff tears (RCTs) are a common cause of shoulder pain and disability in middle and older age. Despite improvements in the understanding of this disease process and advances in surgical treatment, rotator cuff (RC) repair failure rates remain high. Insufficient healing capacity is likely the main factor for failure of reconstruction.
**Materials and methods**: We fabricated implantable biodegradable gelatin-grafted poly (Llactide) (PLLA) fibrous membranes using electrospinning technology and evaluated them using in vitro cell proliferation assays. Then, we established chronic rat RCT models and randomly assigned rats into one of three groups. In group 1 (n=48), the detached supraspinatus tendon was repaired to its anatomic footprint (transosseous repair). In groups 2 and 3, the rats underwent transosseous repair and were implanted with either pure PLLA membranes (n=48) or gelatin-PLLA membranes (n=48) to augment the repairs. The animals were killed at 2, 4, and 8 wk postoperatively, which was followed by histomorphometric and biomechanical evaluation.
**Results**: Histologic observations revealed that gelatin-PLLA membranes have excellent biocompatibility and biodegradability. At 2, 4, and 8 wk postoperatively, the gelatin-PLLA membranes significantly increased the area of glycosaminoglycan staining at the tendon-bone interface compared with the control group ($P < 0.05$) and significantly improved collagen organization, as measured by birefringence under polarized light at the healing enthesis compared with the control and PLLA groups ($P < 0.05$). Biomechanical testing revealed that the gelatin-PLLA group had a greater ultimate load to failure and stiffness than the control group at 4 and 8 wk ($P < 0.05$). The gelatin-PLLA membranes had the highest stress of the healing enthesis.
**Conclusions**: Local application of gelatin-PLLA fibrous membranes to the healing tendonbone interface after RC repair in a rat chronic RCT model was found to strengthen the healing enthesis, increase the area of fibrocartilage, and improve collagen organization compared with repair alone. Augmentation with gelatin-grafted PLLA may enhance healing after RC repair and might eventually lead to improvement of clinical surgical outcomes.
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**B0845**
**LARS reconstruction of anterior cruciate ligament with remnant preservation: A prospective randomized control study**

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**Background**: To compare the short term clinical outcomes of remnant preserving anterior cruciate ligament (ACL) reconstruction with ligament advanced reinforcement system (LARS) artificial ligament and standard ACL reconstruction.
**Methods**: A prospective randomized controlled study was performed in 40 eligible consecutive patients with ACL rupture who were equally assigned into 2 groups from August 2011 through April 2013. Group A (n=20) received ACL reconstruction with remnant preservation technique and group B (n=20) the standard ACL reconstruction. LARS artificial ligament was used for all Cases. The Lysholm score, International Knee Documentation Committee (IKDC) grading and stability assessments (Lachman test, pivot shift test and KT-1000 side-to-side differences) were evaluated pre-and post-operatively. Synovial coverage of the graft and proprioception evaluation were estimated post-operation.
**Results**: All patients were followed up for at least 2 years (mean, 25.7 months) . At the last follow-up, the mean Lysholm score was $96.0 \pm 6.0$ in group A and $93.0 \pm 7.5$ in group B; there were 18 cases of IKDC grading A or B in group A and 14 in group B; 97.4% in group A and 97.6% in group B had negative Lachman test results; 94.9% in group A and 87.8% in group B had negative pivot-shift tests; the KT-1000 side-to-side differences averaged 1.64-1.7 mm in group A and $1.8 \pm 1.8$mm in group B; the synovial coverage of grade A or B was 71.4% in group A and 70.4% in group B; the passive angle reproduction test at 15° was $3.6° \pm 1.8°$ in group A and $3.9° \pm 2.2°$ in group B.
**Conclusion**: In the LARS ACL reconstruction, compared with standard technique, remnant preserving may result in significant improvements in postoperative stability, and proprioceptive recovery of the knee joint.
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**B0847**
**Reliability and minimum detectable change of knee kinematics and kinetics during sidestep cut in female**

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**Background**: Anterior Cruciate Ligament (ACL) injuries are serious and relatively common in sports [1]. Female athletes are two to six times more likely than males to sustain an ACL injury [2]. The knee valgus angles and knee abduction moments measured in vertical drop jumps have been suggested to predict ACL injury [3]. The vertical drop jump test was further used for screening athletes with high risk of ACL injury [4]. However, a recent study argued that sidestep cutting may be more relevant for screening efforts [5].
For use as an evaluative measure, the test must demonstrate high reliability based on the subject variations and the ability to classify subjects. There is no information regarding the reliability of discrete variables such as the peak value and the range of motion. The reliability can be obtained by calculating the standard error of measurement (SEM) and the minimum detectable change (MDC) which are recommended be reported for clinical practice [6]. The MDC is the smallest measured change that can be interpreted as a true difference. Estimates of SEM and MDC enables the researcher to judge whether the change measured in the sidestep cutting, as indicated by kinematics and kinetics measures, represents a true difference between subjects. The objectives of the present study were to evaluate the inter-trial and inter-session reliability of the knee kinematics and kinetics in sidestep cutting task, and to determine the minimum detectable change in female elite handball and football players.
**Material**: Nineteen female handball players and 22 female football players ($21.6 \pm 4$ years old, $168 \pm 5$ cm, $66 \pm 8$ kg) were tested ($n = 41$).
**Method**: The subjects were tested twice by the same personnel, using identical laboratory settings with one to three weeks interval. The subjects performed five trials of sidestep cuttings with match-like intensity in a biomechanics laboratory. Sixteen 480 Hz infrared cameras (Oqus, Qualisys, Gothenburg, Sweden) recorded the movement of 37 skin reflective markers over anatomical landmarks [5]. The ground reaction force (GRF) was recorded by a force plate (AMTI, Massachusetts, USA) collecting at 960 Hz. The knee joint kinematics was calculated by the convention suggested by Grood and Suntay [7]. The following discrete variables were calculated during the contact phase: peak vertical GRF, peak joint moment, joint angle at initial contact (IC), peak joint angle and range of motion, on three orthogonal planes

respectively. The discrete variables of right knee from each trial were used for inter-trial reliability. The mean of five trials were used for inter-session reliability. ICC were used to examine inter-trial (ICC (3, k)) and inter-session (ICC (3, 1)) reliability of discrete variables [18]. The absolute measures of measurements error was accessed by standard error of measurement (SEM) and MDC. Statistical analysis was performed in SPSS 21 (SPSS Inc., Chicago, IL, USA).

**Results**: According to the ICC classifications (greater than 0.75 is excellent) of Fleiss [8], all the discrete variables were excellent in inter-trial reliability. For the knee kinematics, the inter-trial reliability was generally better than the inter-session reliability. The knee flexion angles had higher SEM and MDC than valgus and internal rotation angles. For knee kinetics and peak vertical GRF, the peak knee abduction moment had a larger MDC compared to other moment variables. The peak vertical GRF and the peak knee flexion moment showed an excellent rank correlation between sessions.

**Discussion**: In the present study, the results showed that inter-trial reliability is higher than the inter-session reliability. The possible sources of variability include skin marker placement, body position of the standing static calibration and task difficulty. Among all the discrete variables, peak vertical GRF got the higher value in reliability and rank correlation. It implies that vertical GRF is the most reliable and repeatable variables over time. However, the MDC of the peak vertical GRF is 89.7N, which is large for clinical practice. It implies a difference smaller than 89.7N cannot be regarded as a true difference between two sessions.

The reliability of peak knee valgus angle and moment are of great interest because they have been suggested to be able to predict ACL injury [3]. Both of them achieved an excellent inter-trial reliability. The MDC of peak valgus angle and moment were 2.2° (39% of SD) and 23.1Nm (59% of SD). Although peak knee abduction moment had a high inter-session reliability, the peak knee valgus angle demonstrated a promising MDC with smaller percentage of SD.

**Conclusion**: Among all the discrete variables, the peak vertical ground reaction force is the most reliable variables. Although peak knee abduction moment had a high inter-session reliability, the peak knee valgus angle demonstrated a promising minimum detectable change with smaller percentage of standard deviation.

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**B0848**

**3D printing and characterization of bioactive scaffold potential for reconstructing calcified cartilage zone**

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**Background**: The osteochondral injury is a common disease in clinic, which is a huge burden on society and economy, but the treatment has always been a problem. In view of the importance of the zone of calcified cartilage in maintaining the stable microenvironment of bone and cartilage respectively and promoting osteochondral healing and stress conduction, an organic-inorganic composite tissue engineering scaffolds used to reconstruct calcified cartilage layer were built, and the relationship between calcium magnesium silicate content and the compressive properties of the scaffolds was investigated systematically.

**Materials**: Hyaluronic acid sodium, sodium alginate, collagen type I, $CaCl_2$, $Ca(NO_3)_2 \cdot 4H_2O$, $Mg(NO_3)_2 \cdot 6H_2O$, $Na_2SiO_3 \cdot 9H_2O$, ammonia, anhydrous alcohol, polyvinyl alcohol.

**Methods**: Three-dimensional (3D) printing technique was used to build the scaffolds with highly bioactive calcium-magnesium silicate ultrafine particles of 1%, 3%, or 5% of mass fraction, in which the organic phases were composed of type I collagen and sodium hyaluronate. The as-printed scaffolds were then crosslinked and solidified by alginate/$CaCl_2$ aerosol. Scanning electron microscope (SEM) was used to observe the pore size and distribution of inorganic phase, universal material testing machine to test mechanical properties, and the porosity of scaffolds was also measured.

**Results**: Pore size is approximately $(212.3 \pm 34.2)$ μm with a porosity of $(50.1 \pm 3.1)$%, the compressive modulus of the scaffolds is $(7.2 \pm 1.2)$ MPa on the average, which is irrelevant to the percentage changes of calcium-magnesium silicate.

**Discussion**: Cartilage tissue engineering research lacking in understanding of the integration and isolation effect of calcified cartilage layer uesd to simply focus on cartilage repair. The damage repair of subchondral bone and calcified cartilage layer is often ignored. With the deepening of researches in interfacial tissue, the importance of these three different soft/hard tissue interfaces between ligament-bone, tendon-bone and cartilage-bone has caught increased attention, and breakthrough discovery in osteochondral tissue engineering will be likely made in future and applied in clinic. 3D printing is one of the most commonly used methods in building tissue engineered scaffolds. 3D printing, without any mold or mechanical processing, is very suitable for personalized manufacturing compared with other manufacturing methods, which saves a lot of time and costs. A wide range of material sources can be used in 3D printing, such as natural and synthetic polymers, bio ceramics and composite, which results in good biocompatibility and controllable pore size and shape for cell migration, proliferation and differentiation for the repair of osteochondral defects providing excellent environment. The scaffold for reconstruction of calcified cartilage layer in this experiment is of moderate size, which is bionic to compression performance and composition of calcified cartilage layer to a certain degree. The compressive modulus of the scaffold is irrelevant to the percentage changes of magnesium doped calcium silicate, which is between that of cartilage and subchondral bone.

**Conclusion**: A porous scaffold featuring reconstruction of calcified cartilage layer was successfully fabricated for the first time and compressive modulus of the scaffold is irrelevant to the percentage changes of calcium-magnesium silicate, which lays foundation for building multi-layered composite scaffolds for osteochondral injury in future.

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**B0861**

**Human mesenchymal stem cell-derived exosomes promote orderly cartilage regeneration in an immunocompetent rat osteochondral defect model**

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**Background**: Mesenchymal stem cell (MSC) therapy is currently evaluated in clinical trials for treatment of cartilage injuries. While cell therapy has demonstrated therapeutic efficacy, logistical and operational challenges associated with shipping constraint, storage and proper handling remain. Exosomes are nano-sized, cell-secreted bi-lipid membrane vesicles present in MSC secretome that have been found to mediate the regenerative and immunomodulatory functions of MSCs in treatment of various diseases in animal models. Here, we hypothesize that human MSC exosomes may represent a novel cell-free therapeutic to promote cartilage regeneration.

**Materials and methods**: Accordingly, exosomes were purified from conditioned medium of human embryonic MSCs and evaluated in their ability to heal a critical-sized osteochondral defect in an immunocompetent rat model over a 12-week period.

**Results**: Our results showed that weekly intra-articular injections of MSC exosomes promoted early cellular infiltration and proliferation that facilitated orderly cartilage and subchondral bone regeneration. Analysis of proliferative cell nuclear antigen (PCNA) immunoreactivity showed significantly higher numbers of PCNA positive cells in both the synovium and reparative tissue in animals treated with MSC exosomes than in animals treated with saline ($P<0.001$). Concomitantly, we detected reduced numbers of apoptotic cells in the reparative tissue in animals treated with MSC exosomes. By end of 12 weeks, MSC exosome-treated rats showed a smooth continuous hyaline neocartilage layer and regenerated subchondral bone. On contrary, saline-treated defects showed severe surface irregularity and mostly fibrous/non-cartilaginous tissues with minimal matrix deposition. We also demonstrated that MSC exosomes induced polarization of the synovial macrophages with a regenerative M2 phenotype. Importantly, no adverse reactions were observed in all animals.

**Conclusion**: Taken together, our results show that MSC exosomes are safe and effective, and likely mediate cartilage regeneration through multiple mechanisms. This study provides the basis for future use of human MSC exosomes as a novel off-the-shelf and cell-free therapeutic for cartilage repair in patients.

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